

ASSESSMENT OF ACTIVITY OF TRIUMFETTA RHOMBOIDEA LEAF EXTRACT AGAINST ROOT-KNOT NEMATODE (MELOIDOGYNE JAVANICA) ON EGGPLANT (SOLANUM MELONGENA L.) IN JALINGO

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ABSTRACT

The activity of leaf extracts of *Triumfetta rhomboidea* against *Meloidogyne javanica* was tested in the laboratory and field. Four treatments (crude extract, 5 ml dilution, 10 ml dilution and control-distilled water) were dispensed into petridishes containing 1000 nematode juveniles/eggs each and arranged in completely randomized design in the laboratory. These four treatments were also used in the field on 2mx2m plots arranged in RCBD and replicated three times and application of extract was done weekly for eight weeks. The results showed that the crude extract recorded the highest juvenile mortality (91.5 %) and egg hatch inhibition (88.6 %) in the laboratory. In the field, the crude extract performed better than other treatments in most parameters including plant height (128.22 cm/2017 and 128.20 cm/2018), number of leaves (132.33/2017 and 132.66/2018), shoot weight (1766g.3g/ 2017 and 1768.07g/2018), number of fruits (15.77/2017 and 16.73/2018), yield (43.83t/ha/2017 and 46.60t/ha/2018), final nematode population (174.0/2017 and 160.46/2018) and reproduction factor (0.45/2017 and 0.42/2018) were the lowest of all the treatments. Therefore, the crude extract of *T. rhomboidea* leaf can be applied as drench in *M. javanica*-infested fields to cultivate eggplant cv 'data'.

Keywords: Eggplant cv 'data', crude extract, plant height, *T. rhomboidea*, *M. javanica*

INTRODUCTION

Eggplant (*Solanum melongena* L.) is a Perennial herb which is a member of the family Solanaceae and is grown as an annual plant (Grubben and Denton, 2004). Kalloo (1993) described it as one of few cultivated solanaceous species originating from the old world and is an important vegetable in southern and south-east Asia and in a number of African countries. It is cultivated for its fruits which are consumed as vegetables (Siemonsma, 1981). Eggplant fruit yield depends on factors which include flowering, pests and diseases infection, soil nutrient status and a regime of fertilizer application (Huth and Pellmyer, 1977). *Triumfetta rhomboidea* Jacq. is an annual herb or perennial shrub up to 200 cm tall, erect stem, up to 1 cm in diameter at the base with simple alternate leaves Burkill (2000). The plant is

native to old-world tropics but found throughout the tropical region (Iqbal *et al.*, 2010). Eggplant is susceptible to root-knot nematodes including *M. Javanica*. In eggplant, 50% yield losses and shoot growth reduction occurred when the plants were inoculated with 4.7 and 3.2 *M. javanica* eggs and juveniles/g soil respectively (Moosavi, 2014). Chemical control which was the norm is now being outlawed due to the likelihood of its harmful effects on the environment and nematode resistance (Pandey, 2005; Akhter and Khan, 2018; Thligene *et al.*, 2019). Therefore, avoiding the use of these environmentally harmful chemicals for controlling nematodes necessitated the search for botanicals as this study has done.

MATERIALS AND METHODS

Laboratory tests were carried out in the

Department of Agronomy Laboratory, Taraba State University, in 2017 and a field experiment was conducted in the Teaching and Research Farm of Department of Crop Production Technology, Taraba State College of Agriculture, Jalingo, Nigeria in 2017 and 2018 to assess the efficacy of *Triumfetta rhomboidea* against *Meloidogyne javanica*.

Preparation of Extracts

The leaves of *Triumfetta rhomboidea* were removed by hand from the plant within Taraba State University, Jalingo. After washing, they were shade-dried and then ground to powder using mortar and pestle. The powders were stored in plastic bags. Fifty grams of the powder was turned in to a 5 litre plastic bucket with 500ml distilled water added. The set up was allowed to stand for 48 hours and filtered through Whatman No.1 filter paper. The filtrate obtained was designated as crude extract which was then serially diluted with 5 ml and 10 ml distilled water giving three treatments (PTS1–Crude Extract, PTS2–5 ml dilution, PTS3–10 ml dilution). Also, distilled water was used as control and designated as CT. There was a total of four treatments for each of the egg hatchability and juvenile mortality tests and field experiment. Also, phytochemical analysis of the powder was carried out to ascertain what phytochemicals were present in the powdered leaves of *T. rhomboidea*.

Nematode Eggs and Juvenile Extraction

Identification of the nematode (*Meloidogyne javanica*) was done using the head and stylet morphology as described by Eisenback *et al.* (1981). Second stage juveniles (J2) and eggs of *M. javanica* were extracted from pure culture of infested roots of tomato plants. Nematode juveniles were extracted using the modified Baermann method of Whitehead and Hemming (1965). The juveniles were extracted using shallow trays with sieve lined with tissue paper and macerated roots of tomato placed on it. Water was poured in from the side of the tray to a level just submerging the materials on the sieve. This set up was left to stand for 24 hours and the nematode juveniles were collected by decanting into a beaker. Aliquots of 10ml in syringes were taken and

counted under a stereoscopic microscope using a grid counting dish and 1000 juveniles were used for each inoculation of juvenile mortality test. Nematode eggs were extracted by agitating tomato roots in 0.05% NaOCl (sodium hypochlorite) for 2 – 3 minutes (Hussey and Barker, 1973). The eggs were collected and rinsed with tap water on nested 150- and 25- μ m pore sieves (Dong *et al.*, 2007).

Juvenile Mortality Test

10 ml of the extracts of *T. rhomboidea* in 10 ml syringe was dispensed into petri-dishes containing 1000 juveniles of *M. javanica*. There were four treatments as described under preparation of extracts above arranged in the completely randomized design (CRD), with 12 petri-dishes.

Egg Hatchability Test

A 10 ml syringe was used to dispense 10 ml of *T. rhomboidea* extracts into 12 petri-dishes containing 1000 eggs of *M. javanica*. There were four treatments arranged in the completely randomized design (CRD).

Field Experiment

The experimental field, which was naturally infested with *M. javanica*, was ploughed, levelled, demarcated into 12 plots (with each plot measuring 2 m x 2 m (4 m²), replicated three times (each replication contained four plots) and laid out in a randomized complete block design (RCBD) in 2017 and 2018. Seedlings of a commonly grown local eggplant variety (eggplant cv data) were raised in June (in steam-sterilized loamy soil at 60°C) in 20 cm diameter plastic pots for three weeks and transplanted to the field in July of each of the two years at one plant per stand and nine plants per plot at a spacing of 60 cm x 60 cm. Each three week old seedling was transplanted to the field into a hole drenched with 10 ml extract of *T. rhomboidea*. Subsequent application of 10 ml extracts was done weekly for eight weeks. There were three concentrations (crude extract, 5 ml dilution and 10 ml dilution) and control making four treatments in all. Three plants per plot were sampled for plant height, number of leaves, number of branches, shoot weight, root length,

root weight, number of fruits, fruit weight, fruit girth, yield, galling index, nematode population and reproduction factor. All other agronomic practices were applied as required.

The soil was sampled with an auger at a depth of 0 – 15 cm for soil analysis and initial nematode population prior to the application of treatments. All data collected was subjected to analysis of variance (ANOVA) in SAS procedures and means were separated using LSD (Least Significant Difference) at $p=0.05$ level of significance.

RESULTS AND DISCUSSIONS

Phytochemical analysis of *T. rhomboidea* indicated the presence of saponins, tannins, flavonoids, alkaloids and phenols. From the results, it is evident that percentage juvenile mortality and egg hatch inhibition of *M. javanica* were influenced to some extent by extracts of *T. rhomboidea*.

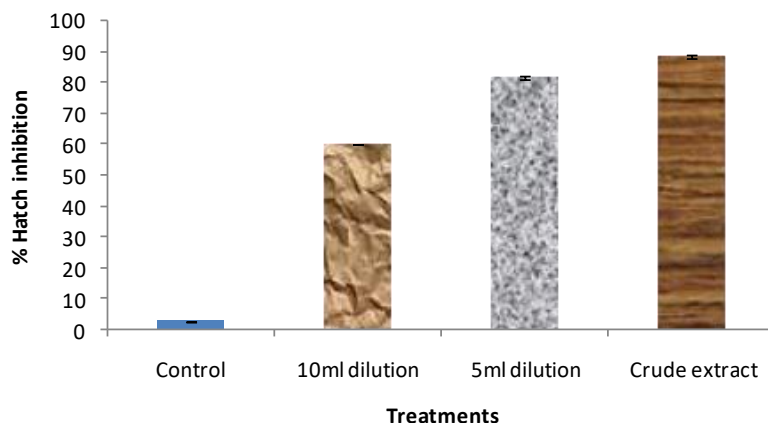
Result of the juvenile mortality test (Figure 1) showed that extracts of *T. rhomboidea* have the capacity to control *M. javanica* juveniles in the laboratory. The crude extract (or 100 % concentration) recorded the highest juvenile mortality with 91.5 % dead *M. javanica* juveniles, followed by the 5 ml dilution (85.2 %) and 10 ml dilution was lowest with 65.0 % mortality. Control was least with 3.50 % mortality. the percentage mortality increased with increase in extract concentration and time of exposure. Sidhu *et al.* (2017) reported that all concentrations of the aqueous extracts from fresh leaves of *Datura stramonium* (20% w/v)

caused the mortality of second stage juveniles of *Meloidogyne javanica* with higher mortality occurring in 1:5 concentrations and the 1:80 concentration recording the least mortality. Also, juvenile mortality decreased as dilution of all the extracts increased and increase in exposure time led to increase in juvenile mortality.

The result of egg hatchability test (Figure 2) indicated that extracts of *T. rhomboidea* recorded significantly higher inhibition of *M. javanica* egg hatch than the control. The crude extract (or 100 %) concentration recorded higher inhibition of nematode egg hatch with 88.60 % than the 5 ml dilution (81.80 %) and lowest was the 10 ml dilution (60.20 %). The least was control with 2.60 % egg hatch inhibition. Aanany *et al.* (2017) reported that extracts from fresh leaves of five different plants (*Acacia arabica*, *Ziziphusspina christi*, *Eucalyptus camaldulensis*, *Lawsonia inermis* and *Dalbergia sissoo*) evaluated against *Meloidogyne javanica* under laboratory conditions revealed that, all treatments significantly ($P < 0.05$) reduced the hatching of egg-masses where the highest reduction was recorded in *A. arabica* with the concentration (S) having 97.13% and S/2 (89.99%), while the lowest reduction was caused by *Z. christi* with the concentration (S) having 45.49% and S/2 (24.63%). Other workers have used extracts to obtain control of *Meloidogyne spp.* Egg hatch and juveniles (Javed *et al.*, 2008; Kichu *et al.*, 2018; D'Errico *et al.*, 2018; Karim *et al.*, 2019).



Figure 1: Effect of extracts of *T. rhomboidea* on mortality of *M. javanica* juveniles

Figure 2: Effect of extracts of *T. rhomboidea* on inhibition of *M. javanica* egg hatch**Table 1: Effect of Extract of *Triumfetta rhomboidea* on *M. javanica* on Eggplant in 2017 and 2018**

	PH (cm)	NL	2017 NB	SW (g)	RL (cm)	PH (cm)	NL	2018 NB	SW (g)	RL (cm)
Crude extract	128.22 ^a	132.33 _a	16.67 _a	1766.30 ^a	59.66 ^a	128.20 ^a	132.66 ^a	18.66 ^a	1768.07 _a	60.86 ^a
5 ml	126.33 ^a	124.22 _{a^b}	15.21 _a	1465.33 ^b	54.66 ^a	126.51 ^a	124.21 ^{ab}	15.22 ^a _b	1465.73 _b	55.50 ^{ab}
10 ml	115.66 ^a	116.55 _b	12.77 _{ab}	1023.53 ^c	44.66 ^b	116.30 ^a	116.77 ^b	12.99 ^a _b	1023.83 _c	45.60 ^{bc}
Control	51.22 ^b	65.99 ^c	8.66 ^b	140.53 ^d	36.00 ^b	51.21 ^b	66.33 ^c	9.66 ^b	139.90 ^d	36.50 ^c
Mean	105.35	109.77	13.33	1099.02	48.75	105.55	109.99	14.13	1099.38	49.61
LSD (0.05)	15.39	13.10	4.42	197.16	9.87	14.49	12.91	6.73	196.68	11.67
SE(±)	10.04	8.16	1.04	186.06	3.02	10.02	8.13	1.29	186.34	3.09

All means in the same column bearing the same letters are not significantly different at $p=0.05$

PH-Plant height, NL-Number of leaves, NB-Number of branches, SW-Shoot weight, RL-Root length, LSD-Least significant difference, SE-Standard error

The result of the field experiment in both 2017 and 2018 showed that extracts of *T. rhomboidea* generally performed better than control in reducing the harmful activities of *Meloidogyne javanica* on eggplant (Table 1). Eggplant cv 'data' treated with the crude extract (100 %) recorded the tallest plants with plant height of 128.22 cm (2017) and 128.20 cm (2018) followed by the 5 ml extract treatment with 126.33 cm (2017) and 126.51 cm (2018) and least was control plants with heights of 51.22 cm (2017) and 51.22 cm (2018). There was no significant ($p<0.05$) difference between the extracts (crude extract, 5 ml dilution and 10 ml dilution) but there was significant ($p<0.05$)

difference between the extracts and control with the extracts recording taller plants than control. Eggplants treated with the crude extracts of *T. rhomboidea* produced significantly ($p<0.05$) higher mean number of leaves (132.33/2017 and 132.66/2018) than the 5 ml dilution (124.22/2017 and 124.21/2018) and the 10 ml dilution (116.55/2017 and 116.77/2018). The least was control with 51.22 (2017) and 51.21 (2018) (Table 1).

The extracts of *T. rhomboidea* recorded significantly ($p<0.05$) higher mean number of eggplant fruits and mean fruit weight than control in both years. For mean number of fruits, the crude extract recorded more fruits

(15.77/2017 and 16.73/2018) than the 5 ml dilution (13.66/2017 and 14.22/2018) and lowest was 10 ml dilution (12.55/2017 and 12.44/2018) (Table 2). The extracts produced significantly ($p<0.05$) higher mean yield of eggplant fruits than control with the crude extracts recording 43.83 tons/ha (2017) and 46.60 tons/ha (2018) and lowest being 10 ml dilution (31.82 tons/ha-2017 and 31.79/tons/ha-2018) (Table 3). Control recorded significantly ($p<0.05$) higher final nematode population (912.00/2017 and 889.63/2018) than all other treatments with least being the crude extract (174.00/2017 and 160/2018). Also, control recorded significantly

($p<0.05$) higher reproduction factor (with 2.39/2017 and 2.33/2018) than all other treatments with least being crude extract (0.45/2017 and 0.42/2018) (Table 3). Bajestani *et al.* (2017) studied the inhibitory effect of medicinal plant extracts including marigold (*Tagetes* spp.), rosemary (*Rosmarinus officinalis* L.) and nigella (*Nigella sativa* L.) on root-knot nematode, *Meloidogyne javanica* on susceptible tomato cv. Karoon and showed that highest percentage of all three plant extracts proved most effective against root-knot nematodes as they reduced number of galls, egg-masses and nematode population in soil.

Table 2: Effect of Extract of *Triumfetta rhomboidea* on *M. javanica* on Eggplant in 2017 and 2018

	RW (g)	NF	2017 FW (g)	FG (cm)	RW (g)	NF	2018 FW (g)	FG (cm)
Crude extract	109.27 ^d	15.77 ^a	123.66 ^a	7.10 ^a	111.66 ^d	16.73 ^a	123.88 ^a	7.22 ^a
5 ml	149.90 ^c	13.66 ^a	120.81 ^b	7.09 ^a	149.70 ^c	14.22 ^a	121.21 ^a	6.92 ^a
10 ml	171.62 ^b	12.55 ^{ab}	112.55 ^c	6.76 ^a	171.93 ^b	12.44 ^{ab}	113.32 ^b	6.98 ^a
Control	251.66 ^a	8.22 ^b	48.73 ^d	4.06 ^b	253.13 ^a	8.44 ^b	48.44 ^c	4.22 ^b
Mean	170.61	12.55	101.44	6.25	171.60	12.95	101.71	6.33
LSD (0.05)	15.83	4.38	2.31	0.65	13.56	4.44	3.10	0.77
SE(±)	15.73	0.96	9.27	0.39	15.69	1.03	9.36	0.38

All means in the same column bearing the same letters are not significantly different at $p=0.05$

RW-Root weight, NF-Number of fruits, FW-Fruit weight, LSD-Least significant difference, SE-Standard error

The application of the extracts of *T. rhomboidea* to the soil probably caused the mortality of *Meloidogyne javanica* in the soil and inhibited egg hatch leading to increased growth and dry matter accumulation as shown in Tables 1, 2 and 3. Also, applying these extracts consistently for eight weeks ensured that the extract was always present in the soil. This probably accounted for the very high preponderance of juveniles in nematode suspensions when final population of *M. javanica* was extracted from soil at the end of

the experiment giving an indication that egg hatch only resumed sometime after extracts application had stopped. The control recorded lower values in the different parameters because there was nothing to interfere with their activity with the attendant higher galling index (Table 3) and higher root weights (Table 2). All this was probably due to the presence of phytochemicals which was reported to have nematotoxic properties (Knobloch *et al.*, 1989; Adegbite, 2003; Trifonovo and Atanasov, 2009; Ojo and Umar, 2013)

Table 3: Effect of Extract of *Triumfetta rhomboidea* on *M. javanica* on Eggplant in 2017 and 2018

	Yield (tons/ha)	GI	2017 FNP	RF	Yield (tons/ha)	2018 GI	FNP	RF
Crude extract	43.83 ^a	2.00 ^a	174.00 ^d	0.45 ^d	46.60 ^a	2.03 ^c	160.46 ^d	0.42 ^d
5 ml	37.13 ^{ab}	2.00 ^a	195.66 ^c	0.51 ^c	38.80 ^{ab}	2.06 ^c	182.40 ^c	0.48 ^c
10 ml	31.82 ^b	3.33 ^a	263.66 ^b	0.69 ^b	31.79 ^b	3.43 ^b	253.43 ^b	0.66 ^b
Control	9.03 ^c	4.00 ^a	912.00 ^a	2.39 ^a	9.21 ^c	4.73 ^a	889.63 ^a	2.33 ^a
Mean	30.45	2.83	386.33	1.01	31.60	3.06	371.48	0.97
LSD (0.05)	11.13	2.37	7.68	0.01	12.03	1.11	6.59	0.01
SE(±)	4.13	0.38	92.05	0.24	4.41	0.35	90.79	0.23

All means in the same column bearing the same letters are not significantly different at p=0.05

GI-Galling index, FNP-Final nematode population, RF-Reproductive Factor, LSD-Least significant difference, SE-Standard error

CONCLUSION AND RECOMMENDATION

It is evident from the results of both laboratory and field experiments in this study that water-soluble extracts of *T. rhomboidea* contain phytochemicals that are toxic to nematodes. The crude extract (100 %) is the most promising of all the extracts. *T. rhomboidea* is commonly and freely available to farmers. In conclusion, *T. rhomboidea* has the potential to serve as a substitute for pesticides that are not friendly to the environment.

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